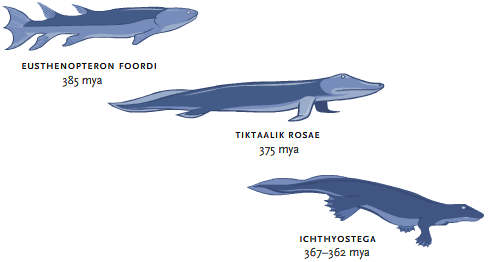
**Cathy Van Saun Writing Lesson 1**

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| **Unit: Geologic Time** |
| **Topic: Fossil Evidence for Evolution** |
| **Type of Writing: Casual (level 1)** |
| **Timeframe: 1 period** |
| **Plan:**   * **Students will read “Fossil Evidence” and complete the re-active reading assignment.** * **Students will discuss what they wrote with their partner.** * **Students will conduct a whole class discussion on the article.** |
| **Materials: “Fossil Evidence” re-active reading assignment.** |

**Fossil Evidence**

In 2004, a field crew digging in the Canadian Arctic unearthed the fossil remains of a half-fish, half-amphibian that would all but confirm paleontologists' theories about how land-dwelling tetrapods (four-limbed animals, including us) evolved from their fish ancestors. The animal was a so-called lobe-finned fish that lived about 375 million years ago. Named *Tiktaalik rosae* by its discoverers, it is a classic example of a transitional form, one that bridges the evolutionary gap between two quite different types of animal. Below, see this and four other well-known fossil transitions, which clearly indicate Darwinian evolution in action.—*Rima Chaddha*

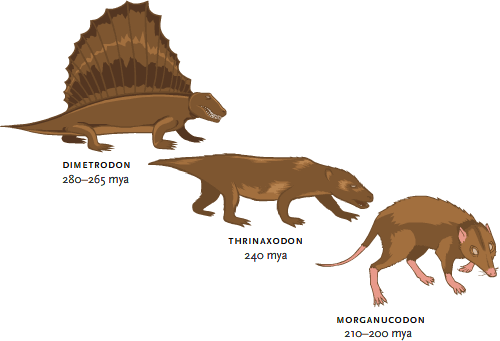
**Notes**: Images not to scale, Dates, in millions of years ago, give the estimated age of known fossils.



**Fish to amphibians**

*Eusthenopteron* looked and behaved a lot like modern fish, but hidden within its fins were the precursors of the arm and leg bones of four-limbed land animals. The later *Tiktaalik* took a further step toward terrestrial life with early wrist and finger bones that allowed the animal to prop itself up and poke its head from the water of the shallow swamps it favored. *Tiktaalik*'s skeleton indicates that it probably breathed both through gills, like *Eusthenopteron*, and through a lung-like structure, like the later *Ichthyostega* and modern amphibians. *Ichthyostega*'s even stronger limbs probably developed so that it could maneuver around thick vegetation in its marshy habitat and even haul itself along muddy banks when necessary.

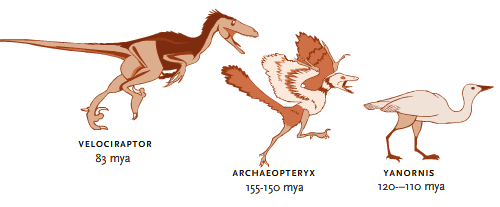
Reaction: Question: Opinion:



**Reptiles to mammals**

Despite its distinctly lizard-like appearance, *Dimetrodon* possessed a suite of traits more common to later mammals than to its close relatives, the true reptiles. Most notably, the sail protruding from *Dimetrodon*'s back allowed the animal to partially regulate its body temperature, marking what could have been a major point in the transition to warm-bloodedness. The later *Thrinaxodon* didn't have a sail but was probably covered in fur and might have been warm-blooded like the early mammal *Morganucodon*. Another documented shift toward mammals took place in the mouth: *Dimetrodon* had differentiated teeth and a strong bite, although it gulped its prey whole like true reptiles do even today. *Thrinaxodon* developed a stronger lower jaw and could chew, but it was *Morganucodon* that sported both sharp teeth and grinding molars like we have today.

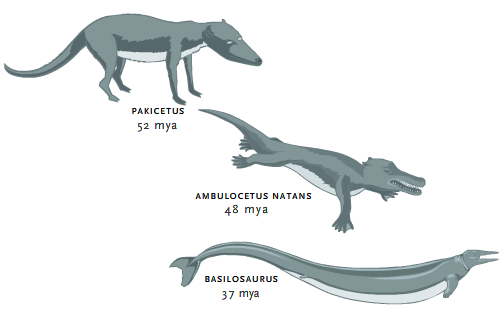
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**Reptiles to birds**

Few topics spark as much controversy among paleontologists as the transition from reptiles to birds. Experts don't know what *Archaeopteryx*'s closest dinosaur ancestor looked like—fossils haven't yet been found—but they think it might have looked somewhat like *Velociraptor* (hence our showing it here, despite its much later age). *Archaeopteryx*, the first known bird, did share a common ancestor with *Velociraptor* as well as traits this ancestor would have had: sharp claws for grasping prey and long hind legs and a stabilizing tail for running, for example. Yet *Archaeopteryx* also had feathers indicative of early flight, although the orientation of its shoulder joint and its lack of a bony breastbone imply the animal was more of a glider than many modern birds—it couldn't lift its wings above its back or flap them for extended flight. *Archaeopteryx*'s later bird relative, *Yanornis*, had a bone structure more conducive to bird flight as we know it today. It could flap its wings and, like many modern birds, it had a short, aerodynamic tail. Like *Archaeopteryx*, however, *Yanornis* did retain some dinosaurian features, including teeth.

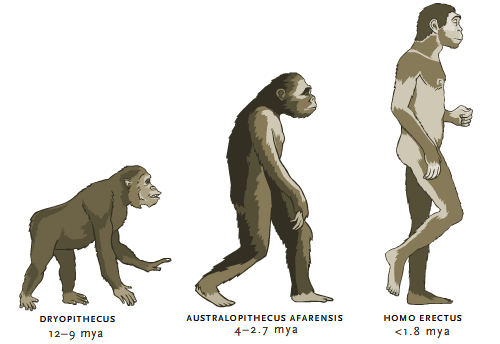
Reaction: Question: Opinion:



**Land mammals to aquatic mammals**

*Pakicetus* may have looked somewhat like a dog with hoofs, but it was actually an early cetacean—a group that comprises the dolphins, porpoises, and whales. The proof, scientists say, lies in *Pakicetus*'s ears, which were intermediate between those of terrestrial and fully aquatic mammals, and in its triangular, whale-like teeth. *Pakicetus* and its relatives were possibly fish-eating scavengers that ventured into the water to find live prey. Although the later *Ambulocetus* had tiny hoofs on its hind legs and could probably walk, its toes were webbed like those of modern mammals adapted for swimming. Its fossilized bones suggest that *Ambulocetus* undulated its spine vertically in the water like the still later *Basilosaurus* (as well as modern otters and whales) and not side-to-side like fish. Although *Basilosaurus* had tiny, weak hind "legs" left over from its evolutionary past, the animal was probably fully aquatic. Its sturdy front flippers were particularly adapted for the water, though they still had an arm-like bone structure as in those of modern cetaceans.

Reaction: Question: Opinion:



**Quadrupedal primates to bipedal primates**

The early ape *Dryopithecus* was probably a common ancestor to humans and the other great apes. Although *Dryopithecus* lived mainly in trees, fossil evidence shows that the animal walked on all fours whenever it descended to the forest floor. In fact, humans' more recent ancestor, *Australopithecus afarensis*, retained some remnants from its quadrupedal past, such as hind toes suited for climbing and a wrist joint indicating it sometimes knuckle-walked. But *Australopithecus* probably stood upright most of the time: Its femur was shaped similarly to that of the later *Homo erectus* and could bear the stress of habitual upright movement. Both protohumans' femurs were also angled inward to an almost knock-kneed position. This helped *Australopithecus* and *H. erectus* maintain their balance on two legs, just like we do today. http://www.pbs.org/wgbh/nova/images02/nav_end.gif

Reaction: Question: Opinion:

Design: Anya Vinokour Illustrations : Amanda Clarke Programming: Brenden Kootsey

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